Comment on ”Are financial crashes predictable?”

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In a recent paper published in this journal, Laloux *et al.* [1] criticized the use of eq.

$$p(t) = A + B(t_c - t)^{\beta} + C(t_c - t)^{\beta}\cos(\omega \ln(t_c - t) - \phi) \tag{1}$$

as a predictive tool for the detection of periods of large declines in the financial markets as first suggested in [2]. The criticism was based on a rather primitive “eye-balling analysis” lacking the consistent methodology used in the identification of more than twenty crashes on the US, Hong-Kong and FX markets alone which all were preceded by a market bubble parameterised by eq. (1) [3]. Specifically, a well-defined optimisation algorithm was used fitting eq. (1) as well as spectral analysis and analysis of synthetic data [3]. They furthermore wrote “We want to publicly disclose here the fact that on the basis of a log-periodic analysis, a crash on the JGB market for the end of May 1995 was predicted. On this basis, one of us (JPA) bought for $\$1.000.000$ of put options ... The crash did not occur and only a delicate trading back allowed to avoid losses”. This represents a severely distorted picture of a scientific experiment. First, the analysis (performed by the author) and experiment was *not* done in May 1995, but in July 1995. In fig. 1 we see eq. (1) fitted to the Japanese bond price in the correct time period of the experiment. Note that the values obtained for the parameters ω and β (see caption) are on the border of what has since been identified prior to over twenty crashes on the US, Hong-Kong and FX markets alone [3]. The result that was borne out of the analysis of July 1995 was that JGB might crash around $t_c \approx 1995.63 \approx$ 19 Aug. 1995. In fig. 1, we see that the market peaked on Wednesday 16 Aug. 1995 at a price 3.96 only to decline over 35 trading days later to a price of 3.36 on 4 Oct. 1995, *i.e.,* a total decline of $\approx 15.2\%$. Admittedly, this does not fit the conventional picture of a market crash, as it is too slow in its unfolding. However, considering the lesser volatility generally seen in the bond markets, this is not very surprising.

In [4] it has been shown that a stretched exponential

$$f(x) = a\exp(-bx^{z}) \tag{2}$$

is a reasonable null-hypothesis for the bulk of the drawdown distribution of the FX, major stock markets as well as individual stocks. A drawdown is defined as a persistent decrease in the price over consecutive days. A drawdown is thus the cumulative loss from the last maximum to the next minimum of the price. As they are constructed from “runs” of the same sign variations drawdowns thus incorporate higher (> 2) order correlations not captured by the distribution of returns. The rationale behind the stretched exponential is that it constitutes the most obvious extension of the very basic hypothesis of a pure exponential. As the definition of “maximum” and “minimum” is not unique except in a strict mathematical sense, a drawdown may be defined in slightly varying ways. The definition used in the present paper is the following. A drawdown is defined as the relative decrease in the price from a local maximum to the next local minimum *ignoring* relative price increases in between the two of maximum size ϵ. We will refer to this definition of drawdowns as “ϵ-drawdowns”, where we refer to ϵ as the *threshold*. In general for stock markets, the largest $< 1\%$ events did not belong to the same distribution as the bulk parameterised by the stretched exponential and have been referred to as “outliers”. In

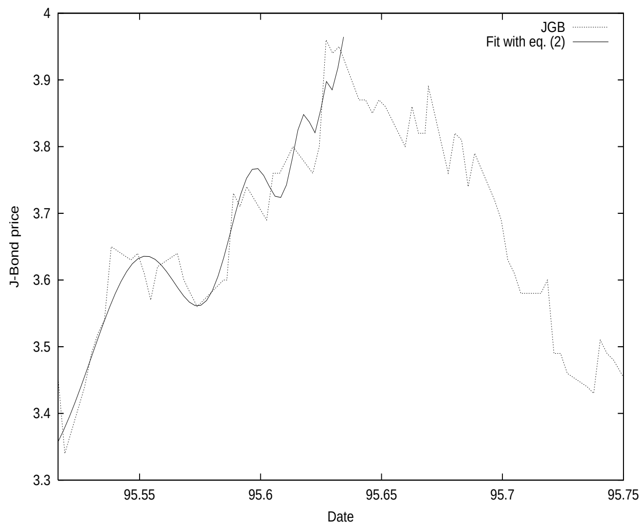

Figure 1: Price of Japanese government bonds fitted with eq. 1. The best fit yields $A \approx 3.97$, $B \approx -1.95$, $C \approx -0.40$, $t_c \approx 1995.63$, $\beta \approx 0.61$, $\omega \approx 7.8$ and $\phi \approx 2.8$.

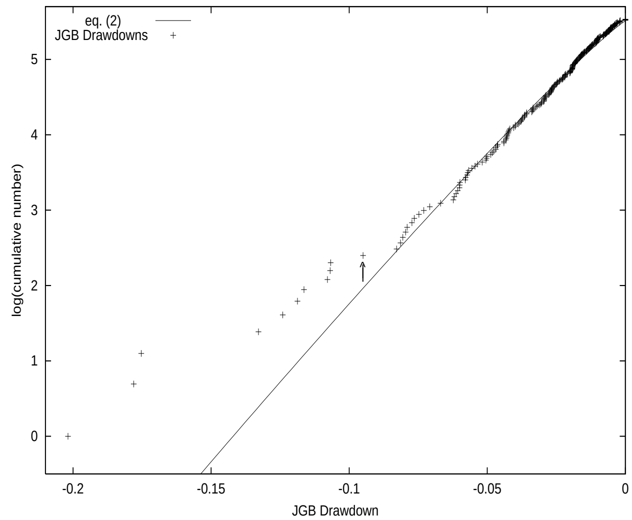

Figure 2: Drawdown distribution in the price of Japanese government bonds 1992.0-1999.2. $\epsilon = 2\%$. The fit with eq. (2) yields $b \approx 46.6$ and $z \approx 1.09$. $a = 237$ events.

fig. 2, the drawdown distribution for JGB the period 1992.00-1999.23 is shown. We see that the distribution of drawdowns except for the $11 < 5\%$ largest events is well captured by eq. (2). Here we have used $\epsilon = 2\%$ corresponding to the size of a "normal" fluctuation. This result support the existence of outliers in the Japanese bond market. That $z > 1$ for JGB further amplifies the suggested existence of outliers in the data due to the downward bend in the distribution this implies. The arrow on the figure indicates the largest drawdown related to the decline ending on 4 Oct. 1995. We see that this drawdown of 9.5% has a clear gap of 1.3% to the previous and that it furthermore clearly lies of the fitted stretched exponential.

In the light of the analysis presented here, the statement in the Laloux *et al.* article [1] re-produced above presents a severely distorted picture of the experiment performed in July/Aug. 1995. Not only is the dating of the experiment *incorrect*, but also the remark that "only a delicate trading back allowed to avoid losses" is exaggerated considering the actual decline in the price. Indeed, the JGB did not crash according to conventional market crash definitions as predicted at that time. However, according to the non-arbitrary outlier definition advocated by the author and D. Sornette in a number of publications [3, 4] it *was* an anomalous event as shown in fig. 2. With respect to the slow unfolding of this 15% drop, we note the similarity to the slow stock market crashes of 1962 and 1998 [3]. This is also true for the rather large value of β. Last, we want to stress that in order to compare the use of eq. (1) on *e.g.*, different times series, the "eye-balling analysis" used in [1] is completely useless due to the bias such a non-objective analysis introduces.

References

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[2] D. Sornette, A. Johansen and J.-P. Bouchaud, J. Phys. I. France 6 167-175 (1996)

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[4] A. Johansen and D. Sornette, J. of Risk, vol. 4, Number 2, Winter 2001/02 and cond-mat/0010050 and references therein.